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Published in:
Landscape and Urban Planning

DOI:
10.1016/j.landurbplan.2019.103621

Publication date:
2019

Citation for published version (APA):
Conrad, E., Fazey, I., Christie, M., & Galdies, C. (2019). Choosing landscapes for protection: Comparing expert and public views in Gozo, Malta. *Landscape and Urban Planning*, *191*, [103621]. https://doi.org/10.1016/j.landurbplan.2019.103621

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Choosing landscapes for protection: comparing expert and public views in Gozo, Malta

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Abstract

Landscape designations are widely used as a basis for land-use policy and planning decisions, with these often based on technical expert assessments. However, there is limited consideration in the literature of the extent to which such expert-based designations reflect public views. This is relevant when considering the strong emphasis of the European Landscape Convention on ensuring that public perceptions are reflected in landscape decisions. In this study, we use the results of a survey to generate public perception-based landscape character and change maps for the island of Gozo (Malta). We consider three different respondent sub-groups and evaluate the degree of concordance between results obtained and landscapes recommended for designation by experts. Results indicate a poor fit between expert-based and public-based results, with >70% of expert-recommended areas not considered to be of particularly high landscape character by the public, and conversely, with > 50% of areas considered to be of high character by the public not included within areas identified by experts as meriting protection. The spatial distribution of these areas was also poorly correlated. Furthermore, clear differences between public and technical judgements of landscape change were evident, particularly in the case of urban landscapes. The study has important implications, showing that expert-based landscape designations may not accurately or adequately reflect public views on valued landscapes and suggesting the need for additional public input to inform decision-making. Our results also indicate the importance of adopting comprehensive protection, planning and management approaches that consider not only outstanding but also more everyday landscapes.

Keywords: Landscape character; landscape change; European Landscape Convention; landscape planning; mapping

1. Introduction

There is growing evidence showing that the current pace of global change has large-scale negative implications for nature and human well-being (IPBES, 2018). Protected areas take on an especially critical role in this context, with research showing that, despite their shortcomings, these remain one of the most effective tools for conservation (Rodríguez-Rodríguez & Martínez-Vega, 2018). At the same time, in the light of ever-increasing pressures, there has been growing recognition of the need to consider protected areas within the context of their wider landscapes and seascapes, and to ensure that these are integrated into all sectors of society (Juffe-Bignoli et al., 2014). Linked to these developments, a relatively-new paradigm of participatory conservation *with* and *for* local communities (Phillips, 2003) has now become firmly established as the desired norm (Andrade & Rhodes, 2012), even if critics remain (Locke and Dearden, 2005; López-Bao et al., 2017). This development is reflective of a post-normal science view that there are no technical, value-free solutions to policy problems and that due consideration of public values is therefore a must (Dryzek, 2013; Niedzialkowski et al., 2018).

Notwithstanding the above, decisions on which areas to protect have often been based on expert judgment, with limited or no consideration of public values. Protected areas with a long history may have been designated at a time when, not only was there no expectation of public influence on decisions, but when the public was not even in a position to contest forced enclosure or clearance (Brockington et al., 2008). In the past, protected areas were often selected either on an *ad hoc* basis, such as in areas that were not valuable for other purposes (Branquart et al., 2008), or solely on the basis of technical judgment and even today, assessment and designation processes remain dominated by expert assessments (Butler and Berglund, 2014). This raises the possibility that there may be a mismatch between designated landscapes and landscapes that are considered valuable by the present-day public. The aim of this research is therefore to

examine the extent to which expert judgments on landscapes meriting protection reflect public perceptions. The study focuses on the Mediterranean island of Gozo, Malta, and uses an internet survey to obtain insights on public perceptions of landscapes; these results are then used to generate perception-based maps of landscape character and change. Specifically, the research examines how both landscape character and change are perceived by the public, and the extent to which identified high character/change areas match up with those areas recommended for designation by experts.

The paper first discusses approaches to landscape designation and methods for eliciting public perception, before describing the empirical case study. The paper makes both a substantive and a methodological contribution, as follows: (i) we highlight shortcomings of landscape designation processes that have relevance beyond the case study area, and (ii) we propose a means for eliciting public views of landscape that can be widely applied. The paper is therefore of relevance to landscape and conservation practitioners, as well as to researchers interested in enhancing the role of the public in decision-making.

2. The need for more public involvement in landscape designation processes

The European Landscape Convention establishes a clear definition of landscapes as *"areas, as perceived by people"* (Council of Europe, 2000), arguing strongly for communities to have a role in the characterization and management of their landscapes. However, the approach by which landscapes have been designated thus far may be far removed from this ideal. In this section, we highlight three reasons why designated areas may not reflect public perceptions. These include: (i) because designated landscapes may be based on historical decisions made before participatory processes were included, (ii) because expert knowledge is often the only

form of knowledge considered, or tends to be privileged over other forms of knowledge, and (iii) because of the focus on certain landscape evaluation criteria over others.

The first reason for limited inclusion of public perceptions in landscape designation is often due to designations having a long history. In Germany, for example, the basic concept of a Landscape Protection Area dates back to 1935 and the Reich's Nature Protection Act, with its later formalization as a discrete protected area category in 1976 (Bundesamt für Naturschutz, 2017); specific designation decisions are based on criteria laid out in law by public authorities in the various German states. Similarly, the process for establishing local landscape designations in Scotland dates back to 1962, when local planning authorities were required to survey areas of great landscape value (AGLV), and to prepare a written statement of the general character and quality of the area, define the boundaries, and develop policy for control and phasing of development (Scott and Shannon, 2007). A review by Bishop et al. (1997) shows that several UK designations with landscape protection as a primary objective date back many years – Areas of Outstanding Natural Beauty (AONB), Heritage Coasts, and National Scenic Areas, for example, originate in 1949, 1970, and 1986, respectively. Designation decisions are made by public bodies, such as Natural England, the English government's advisory body on the natural environment. This long history is relevant, first because protected areas may change over time, with possible loss of or change in the assets that would have qualified them for designation in the first place. Terra et al. (2014), for example, document extensive landscape changes in protected areas in Brazil over a 45 year time frame, while Martinuzzi et al. (2015) project that future land-use changes are likely to be a common challenge to the management of several protected areas in the United States. Second, even if the boundaries of designated areas have been revised since initial establishment, the point is nevertheless significant because it strongly suggests that protected areas may have been chosen at a time when public participation

in decision-making was neither common nor expected, and when there was strong reliance on expert technical judgment as the basis for policy.

A second reason why landscape designation processes may not reflect public perceptions is that expert knowledge continues to be privileged in landscape characterization processes and in mapping initiatives. These may include a degree of public consultation but generally remain far removed from considering landscapes exclusively or even primarily as *"areas, as perceived by people"*. For example, Butler and Berglund (2014) found that of 52 Landscape Character Assessments (LCAs) reviewed, only a quarter even considered the views of 'communities of place', and in some cases, this involvement was limited to providing feedback on expert assessments. Similarly, in a review of planning mechanisms in England, Norway, Slovakia and Malta, Conrad et al. (2011a) find that the rhetoric of public participation does not appear to be adequately reflected in actual landscape planning practices. Mercado-Alonso et al. (2017) note that experts' values are proportionately over-represented as a basis for decision-making and argue that a balance between expert knowledge and knowledge of the people in landscape matters is essential. Notwithstanding, there is evidence that, even in the wider practice of land-use planning, the involvement of the public often remains limited to information and dialogue (Gardesse, 2015) and underlying power dynamics and decision-making structures that privilege expert knowledge may remain unchanged (Flannery et al., 2018).

Finally, designated landscapes may not be sufficiently reflective of public views because their designation is often based on limited criteria and the exclusion of others. Various attributes of valuable landscapes are highlighted in the literature, including ecology or nature conservation, cultural, recreational, therapeutic, and spiritual values, sense of place, and scenic qualities, among others (Cerveny et al., 2017; Raymond and Brown, 2006), together with socially

constructed values produced through direct personal or collective experiences (Tuan, 1977). Formal designation processes, however, tend to focus disproportionately on ecological value or visual aesthetic qualities, as is evident in designations such as Areas of Outstanding Natural Beauty (AONBs) in England, Wales and Northern Ireland and equivalent National Scenic Areas in Scotland. Ellison (2014) highlights the importance that an aesthetic appreciation of 'picturesque' landscapes has had in determining priorities for land protection in both the United States and China, even as concepts of what is picturesque change over time. Similarly, Seger (2014) argues that landscape protection designations in Sweden have been strongly influenced by conceptions of *nature* and related associations of pure, wild, unmodified spaces, distant from human influence. This is perhaps due to the relative ease with which such values can be measured or mapped, as compared to dimensions like sense of place or spiritual value and other socially constructed values.

These three reasons - history, continued privileging of expert knowledge, and disproportionate attention to certain criteria – lead to the possibility that designated landscapes do not accurately reflect the views of the communities that inhabit and interact with these landscapes. Yet there has been very little analysis of whether this is the case or of the extent to which this occurs. This study aims to contribute to filling this gap.

3. The need for new methods for eliciting public views

A variety of methods have been used to elicit public views relating to landscapes, including questionnaires and interviews (e.g. Hami and Maruthaveeran, 2018), meetings and workshops (e.g. Ernoul et al., 2018), and simulation, photo-based, and visualization techniques (e.g. Tobias et al., 2016), among others. While there is evidence that many such techniques are effective at communicating public perceptions, information obtained is often not in a format

that can be easily mapped. This study is concerned specifically with methods that provide information that can be mapped, since protected areas necessarily need to be clearly delineated in space. Of growing popularity in this regard are direct mapping approaches, such as Public Participation Geographic Information Systems (PPGIS).

PPGIS approaches generally have in common the use of community mapping to produce knowledge of place (Brown and Weber, 2011). Such direct mapping approaches can help empower grassroots communities and allow more interaction and collaboration in planning (Harrison and Haklay, 2002). However, PPGIS methods have limitations that may significantly limit their ability to accurately reflect public perception. For example, Anderson et al. (2009) found that effective use of PPGIS tools requires a greater degree of GIS expertise than may be present in a community, while challenges in uptake and rates of participation have also been identified (Brown and Kytta, 2014). Brown et al. (2015) also note issues with spatial accuracy and completeness of PPGIS data, recommending that, at a minimum, PPGIS spatial model inputs be modified to adjust for sources of error. Some of these limitations may relate to wider issues with map literacy and spatial cognition (Larangeira and van der Merwe, 2016; Otto and Red'kin, 2017). For example, a recent survey with 2000 respondents identified map reading as the traditional skill most in danger of dying out (Ordnance Survey, 2015) and the National Center for Education Statistics in the US reported that, in 2010, only 20% of school-age students were proficient in geographical concepts and skills, and 30% did not achieve even a basic level of understanding (National Centre for Education Statistics, 2011). Map illiteracy issues have even been identified amongst planning professionals in South Africa (Engel, 2004; Rautenbach et al., 2017) – (since both South Africa and Malta are former British colonies, both have planning systems based on the British planning model (Scholz et al., 2015)). Such results suggest possible limitations to the accuracy of results obtained through any participatory

mapping approaches, not only PPGIS. It is therefore useful to explore alternative methods for eliciting public views that do not require direct mapping.

The choice of method for eliciting public views should also be informed by the extent to which participation is an established element of planning practice. The reluctance by many planners to change existing technocratic practices and meaningfully embrace participatory approaches (Flannery et al., 2018) is well recognized, with this common even where collaborative or communicative planning practices have been attempted. Furthermore, planners may lack both the resources for and knowledge of how to 'do' participation, with Nolan and March (2016) suggesting a tendency for planners to merely rely on routine mechanisms or on large and symbolic participatory exercises, without any real engagement with or responsibility for participation in day-to-day practice. Hartmann (2012) indeed characterizes public participation in planning as a potential wicked problem, noting that we should not simply argue for more participation in a blanket manner, but rather acknowledge that participation needs to be tailored to the different expectations of those involved; he further makes a case for 'clumsy' solutions, that may be less than perfect but that are responsive to different rationalities and therefore more appropriate.

In this study, we develop a relatively simple indirect mapping approach for public input that does not necessitate radical changes in planning practices. Our proposed approach does not require map literacy among respondents and also does not require that planners have expertise in participatory methods, but allows for public views to be considered and to a much greater degree than is often the case, extending the involvement of the public beyond the provision of feedback to the strategic phase of planning. We argue that this may be less ideal than more

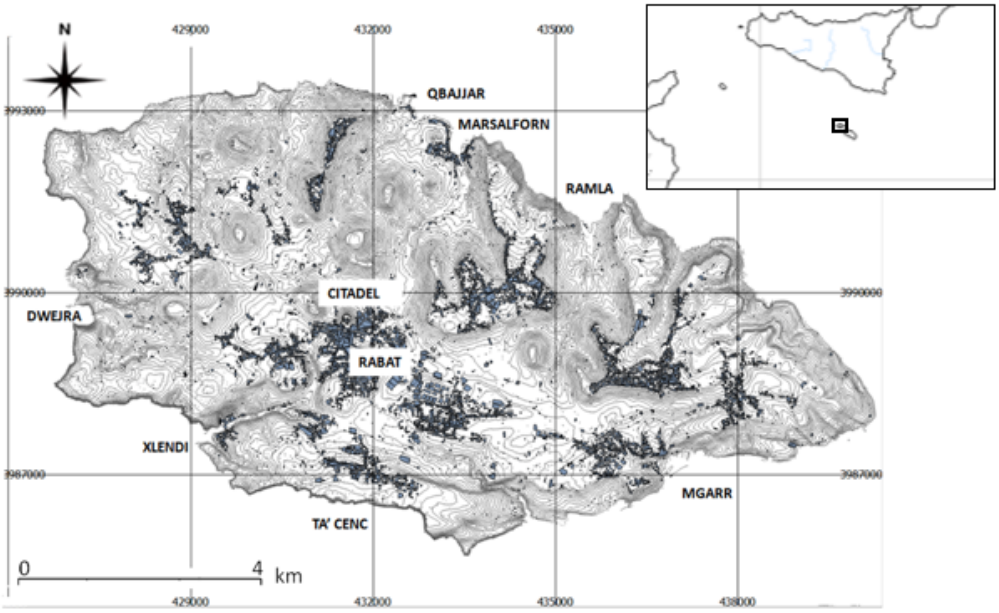
participatory approaches but more practicable in contexts where the latter remain challenging. This method is described below.

4. Methodology

4.1 Case study

In order to assess the difference between public and expert views of landscapes, and how these relate to designated protected areas, this study focused on the island of Gozo (Fig. 1), the second-largest island of the country of Malta, with a population of 32,206 individuals (National Statistics Office, 2018a) and a size of 67.1 km^2. The island is characterized by hilly Upper Coralline Limestone plateaux; in between lie plains on which softer limestones have been exposed, with several valleys also bisecting the landscape. Tectonic movements have tilted the island complex in such a way that steep sea cliffs characterize the southern and parts of the western coast of Gozo, with gentler rocky shores and platforms and sandy beaches to the north. There are 14 towns and villages across the island, many of which remain spatially distinct, unlike on the main island of Malta, where towns have mostly merged into a single large conurbation. The main land use on the island in terms of spatial coverage is agriculture; the island also relies heavily on tourism for economic revenue. Presently, the only link between Gozo and the main island of Malta is through a ferry connection, although plans are currently underway to establish a permanent link between the islands through an underwater tunnel.

Figure 1: Overview of Gozo. The map indicates topographical variation across the island and major settlement areas. Key place-names listed in the text are also indicated.



Gozo was selected as a case study for the following reasons: (i) because it has a diverse landscape with many different natural and cultural elements within a relatively small area; such heterogeneity was considered to be useful for testing of our method, to ensure that this would allow accurate capture of views of even diverse and complex landscapes; (ii) because the presence of a natural boundary (the sea) allowed a comprehensive analysis of the entire landscape, (iii) because it is regularly frequented by different stakeholders, including residents, visitors from the main island of Malta, and tourists, who may value different aspects of the landscape, and (iv) because effective protection of its landscape is a timely concern. Gozo (and Malta in general) also provides a good illustration of the three reasons given in Section 2 for why more public involvement in landscape designation decisions may be necessary. As explained below, the local designation process has tended to privilege expert opinion (reason 2) and to be based on only a few select criteria (sensitivity and to a very limited extent, scenic value) (reason 3). While the history of designated areas in Malta is relatively young, the public

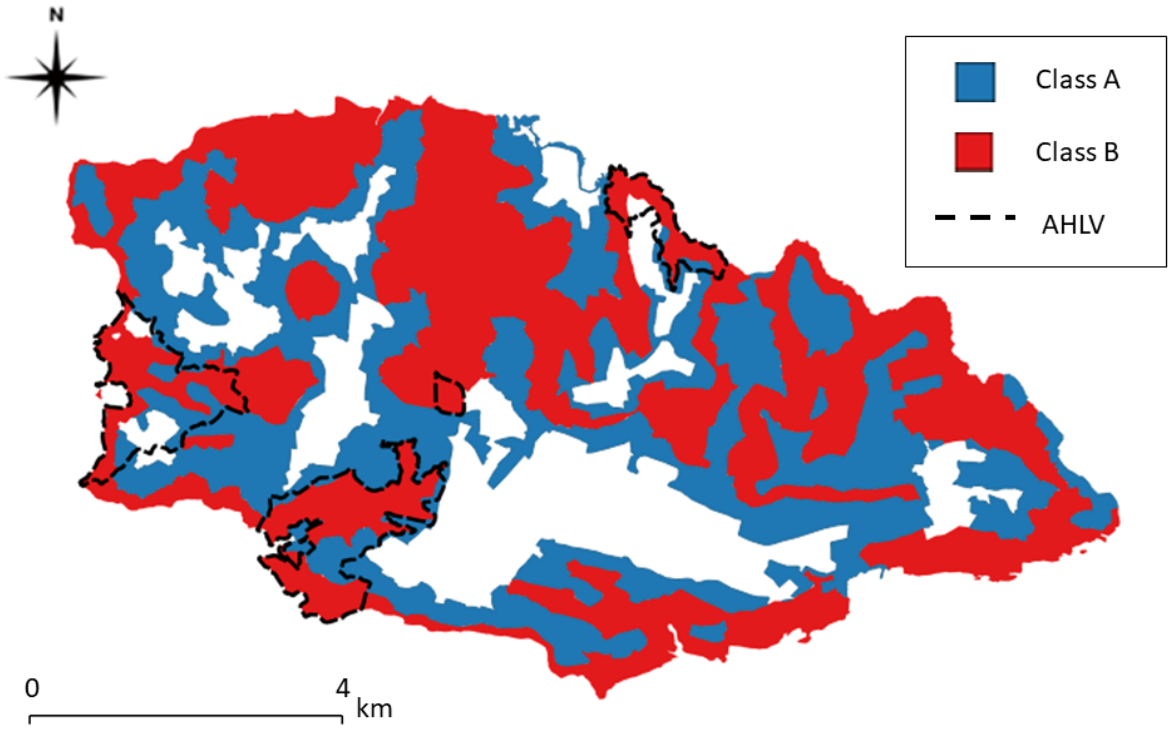
participation imperative is nevertheless weak (reason 1) even as the country's landscapes have experienced very rapid change. These points are explained further below.

Malta is one of only two Council of Europe Member States to have signed but not ratified the ELC, the other being Iceland. (A further six Member States have neither signed nor ratified the ELC, while all 39 other Members have done both). Nevertheless, there is a commitment to safeguard the landscape within the Maltese Constitution (Constitution of Malta, 1964). The Landscape Assessment Study of the Maltese Islands (LAS) (Malta Environment and Planning Authority, 2004) subdivided Malta into 96 different landscape character areas and mapped the country in terms of landscape sensitivity, the latter based mainly on intervisibility between a site and surrounding physiography. The methodology adopted was based on the formal aesthetic model, with some aspects of the psychophysical model (Malta Environment and Planning Authority, 2004). The former draws on the language of aesthetic philosophy to describe aesthetic qualities of the landscape (Zaleskiene and Gražulevičiūtė-Vileniškė, 2014), with the judgment of experts trained in aesthetics playing a vital role (Tveit et al., 2006); the psychophysical model takes into account people's judgments about scenic beauty based on features of the physical landscape (Ndubisi, 2002).

In the LAS, a landscape assessment model was first developed based on expert judgment; quantifiable landscape components were identified and values were given to the various features, with positive and negative values assigned to enhancing and detracting features, respectively. Public input in the process was limited to a research exercise carried out in parallel, which asked members of the public to rate 40 photographs of Maltese landscapes. Through GIS development and interpolation, the landscape hierarchy model was eventually refined into five classes (on a 50 m × 50 m grid), based on decreasing sensitivity to change.

The top two classes (very high and high sensitivity, respectively) correspond directly to areas considered to be of very high and high landscape value (referred to as classes A and B in this study, Fig. 2). These areas (both classes) were recommended for statutory protection, through scheduling of Areas of High Landscape Value (AHLVs). The aim of AHLVs is to ensure controls on developments that may compromise landscape character; as indicated in the LAS, the presumption is that "*areas with the highest level of landscape sensitivity should only allow those interventions which maintain the existing landscape and remove the incongruous elements"* (p. 177).

Figure 2: Distribution of Class A and B areas across Gozo and currently-scheduled landscapes. Class A and B areas represent those that were identified by experts as being of very high and high sensitivity/value, respectively and that were recommended for statutory protection. Existing scheduled areas are those that have thus far been formally given such protection.

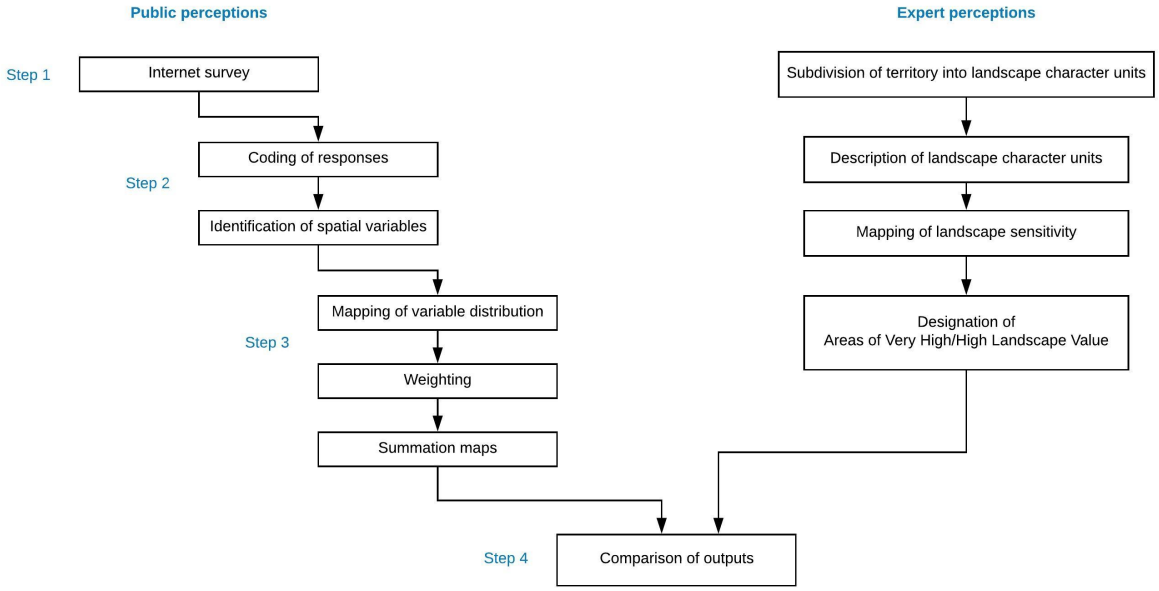


Class A and B areas identified in the LAS extend over 51% of the entire country. Several such areas in Malta are now formally scheduled; however, at the time of writing, relatively few such areas in Gozo had yet been formally scheduled (Fig. 2). The reasons for this are unclear, though possibly related to a recent reorganization of planning/environmental management remits and related bureaucratic delays; it is also unclear whether there are any intentions to extend the current suite of protected landscapes in the short term. To the authors' knowledge, there are currently no plans for a landscape assessment exercise to be repeated. For these reasons it is likely that, in the short term at least, any extension of the protected landscape network will be based on the 2004 LAS expert-based exercise that is considered in this research.

4.2 Methods

This research aimed to understand how well expert opinion on landscapes meriting protection reflects the views of the public. The latter were elicited through an internet survey, the responses to which were used to generate maps of perceived landscape character and change (Fig. 3; see Section 4.3 for details of method). The locations identified by the public as high character and high change areas were then compared to the location of class A and B landscapes, i.e. those considered to be most valuable by experts and worthy of designation. Our approach provides a novel, indirect mapping methodology through which public values can be elicited, to feed into future designation/modification of protected areas.

Figure 3: Overview of methods adopted in this study (left) for deriving public-perception based maps, as compared to methods used for expert-based mapping.



The methods and premises that underpin the expert assessment differ from those that underpin the public survey in this study. In the former case, judgments of landscape value are based on sensitivity and scenic value; in the latter case, they are based on attributes of landscape character. In both cases, the intended end point is identification and mapping of areas of high landscape value that merit protection. In this study, we specifically explore whether these different starting points produce different end results. This comparison is important, because as noted earlier, the aim of AHLVs is specifically to ensure controls on developments that may compromise landscape character. In other words, it is presumed that areas identified by experts are not only highly sensitive, but also have high landscape character and value. Our work examines to what extent this is actually the case, based on the views of the lay public. The steps involved are outlined in detail below:

Step 1: Data collection

An internet survey, discussed in detail in Conrad et al. (2011b) and summarized in Table 1, was developed to identify people's perceptions of: (i) landscape character and (ii) landscape change. Following pilot testing, the survey, data for which was collected over several months in 2009-2010, was made available in both Maltese and English, the two official languages of Malta. For the purposes of this study, landscape character was considered a proxy for value; this is because, as described above, the expert-based landscape assessment was based on an evaluation of landscape features (natural and cultural). The aim of AHLVs is also specifically to safeguard the existing landscape. Similarly, we investigated change, first because of the emphasis in the European Landscape Convention on managing change, second because of the focus in the expert-based assessment on sensitivity to change as a main criterion determining landscape value, and third, also to investigate whether there is any spatial relationship between character and change. Any such relationship would have important implications for landscape planning.

Specifically, respondents were asked in the survey to:

1. Identify and list specific aspects of the Gozitan landscape that contribute to landscape character and distinctiveness;
2. Identify and list specific aspects of the Gozitan landscape showing long-term landscape change.

The terms character and change are commonly used in vernacular language and no definitions were therefore provided. The two questions allowed for open-ended responses and respondents were given the option of listing up to five different landscape aspects of character and change in each case.

Table 1: Survey overview (from Conrad et al., 2011b). This study utilized mainly data from questions B3 and C3, also with some discussion of results for questions C1 and C2.

Introduction to survey			
		Close-ended	Open-ended
A. Perceptions of landscape as a concept	What comes to mind when you hear the word 'landscape'?	×	✓
Think of landscape as an area of land, in whichever way you perceive it, as your experience of a place.			
B. Perceptions of landscape character	1. Do you think Gozo has distinctive, characteristic landscapes, which contribute to a sense of place?	✓	×
	2. If yes, do you think this character is a positive or a negative aspect?	✓	×
	3. Can you think of specific aspects of the Gozitan landscape that lend this character and distinctiveness? Please list.	×	✓
C. Perceptions of landscape change	1. Do you think that Gozitan landscapes are showing trends of long-term change?	✓	×
	2. If yes, is this change predominantly positive or negative?	✓	×
	3. Can you identify specific aspects of the Gozitan landscape that show such change occurring? Please list.	×	✓
	4. Do you think that the character of Gozo's landscape is threatened in any way by landscape change? Please provide details for your answer.	✓	✓
D. Future visions	What would you like Gozo's landscapes to be like in the future? Please provide details for your answer.	×	✓
Additional respondent comments		×	✓
Collection of socio-demographic data • Stakeholder category • Age • Gender		✓	×
Survey conclusion			

A snowball sampling strategy was adopted to encourage responses to the internet survey, with the link to the survey disseminated to acquaintances, who were in turn asked to send on the link to their own acquaintances. While snowball sampling is potentially prone to selection bias, it provides for reduced cost and enhanced efficiency, and was particularly appropriate in the cultural context of Gozo, where the close-knit and somewhat guarded society makes it more likely that responses will be given if contact is made through an acquaintance, rather than initiated by a stranger. In total 478 individuals responded, split across three stakeholder groups: (i) local residents of Gozo (n =103), (ii) domestic visitors to Gozo from the island of Malta (n = 288), and (iii) international visitors to Gozo (n = 32).

Step 2: Data processing

Responses were coded qualitatively (with the aid of the NVIVO 8 software package) (Table 2) to highlight common elements amongst the responses and identify spatial variables to be included in the mapping phase of the research. The coding process focused on spatial features which could be directly identified in space and mapped (e.g. *hills, quarries*), whilst others referred to spatial phenomena for which proxy spatial indicators needed to be identified (Table 3). The process therefore tended to exclude: (i) subjective or ambiguously worded concepts (e.g. *beauty, historical richness*), (ii) responses with no clear spatial dimension (e.g. *buses, development of local produce*), and (iii) features/phenomena with a uniform spatial distribution across Gozo (e.g. *blue skies, climate change*). At the end of the coding process, 89 landscape character variables (Table S1) and 45 landscape change variables (Table S2) were identified for the subsequent mapping exercise (Table 4). Differences between responses according to stakeholder category, age, and gender were analysed for significance using chi-squared tests and z-tests; results are described in Conrad et al., 2011b.

Table 2: Coding protocol - common elements were identified from the initial variety of survey responses. The aim of the coding process was to extract key common themes from initial results.

	Coding criteria	**Example**
1	Maltese place-names converted to English place-names	*Wied il-Ghasri* recoded as *Ghasri valley*
2	References to closely related features or different aspects of same feature recoded as a general variable for the group of features	*Church domes, church spires, cathedrals, chapels* recoded as *churches*
3	Differently worded references to the same spatial feature/phenomenon recoded as a single variable	*More building, increased urban footprint, spread of villages* recoded as *urbanization*
4	Responses incorporating more than one variable split into separate variables	*Cliffs and hills* recoded as *(i) cliffs* and *(ii) hills*
5	Variables at very fine resolution recoded as more broad scale features	*Thyme patches* recoded as *natural land cover*
6	Removal of detailed response descriptors	*Lush valleys* recoded as *valleys*
7	Non-spatial variables linked with a related spatial feature (where possible)	*Farmers* recoded as *agricultural land cover*
8	Different variables with the same spatial extent (for the purposes of this study) recoded as a common variable	*Sea* recoded as *coast*

Table 3: Identification of mapping variables through coding - the initial variety of responses was substantially reduced as key themes were identified. Subjective variables, as well as those with no, or a uniform, spatial distribution across Gozo were excluded from the mapping process.

	No. of initial responses	**No. of variables (following coding)**	**Excluded variables**	**Mapping variables**
Landscape character	1290	109	20	89 of which 1 proxy variable
Landscape change	847	68	22	45 of which 3 proxy variables

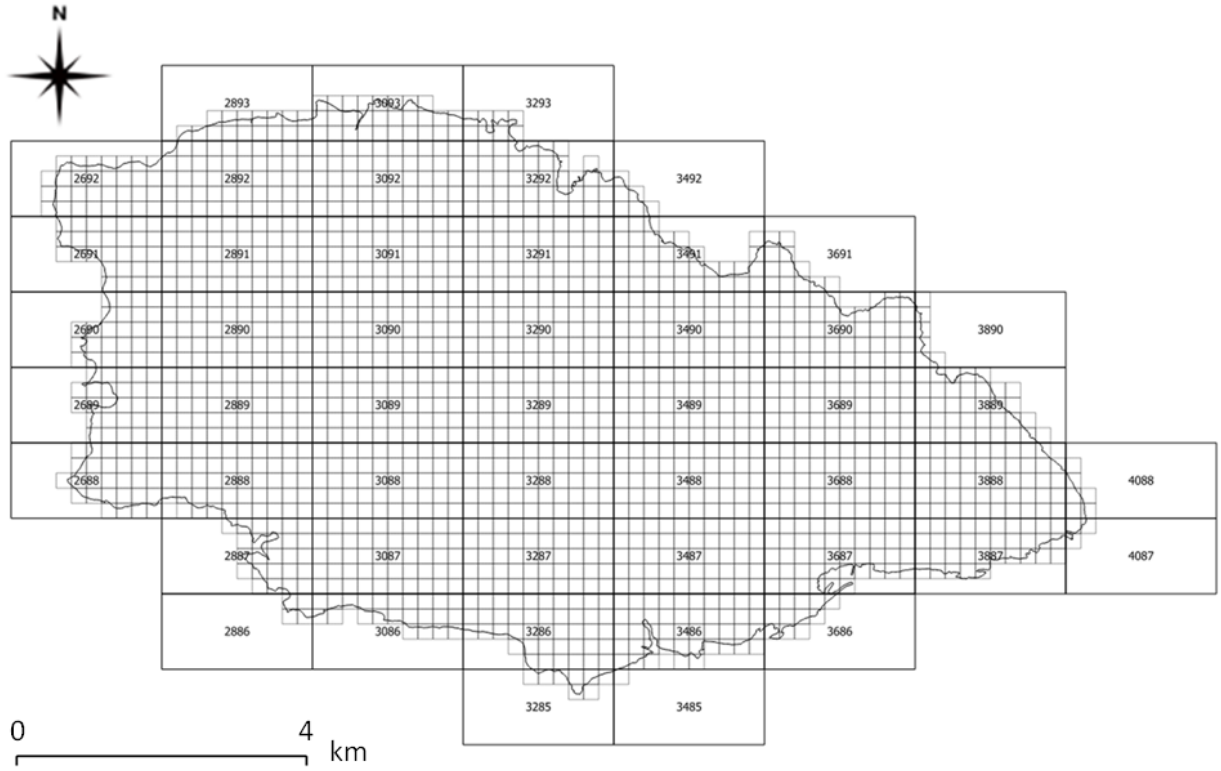
Table 4: Identification of proxy variables - for features with a spatial dimension but which could not be directly mapped.

Response variable	**Proxy mapping variable**
Landscape character	
1. Traditional architecture	Farmhouses, terraced houses, detached/semi-detached houses
Landscape change	
1. General urbanization	Sites of new building permits issued between 1998 and 2008
2. Changing architectural styles	Sites of building permits issued for construction of apartment blocks and/ or penthouses (both new developments and conversions) between 1998 and 2008
3. High-rise development	Areas within development scheme boundaries (recently revised) where permitted building heights are over four storeys

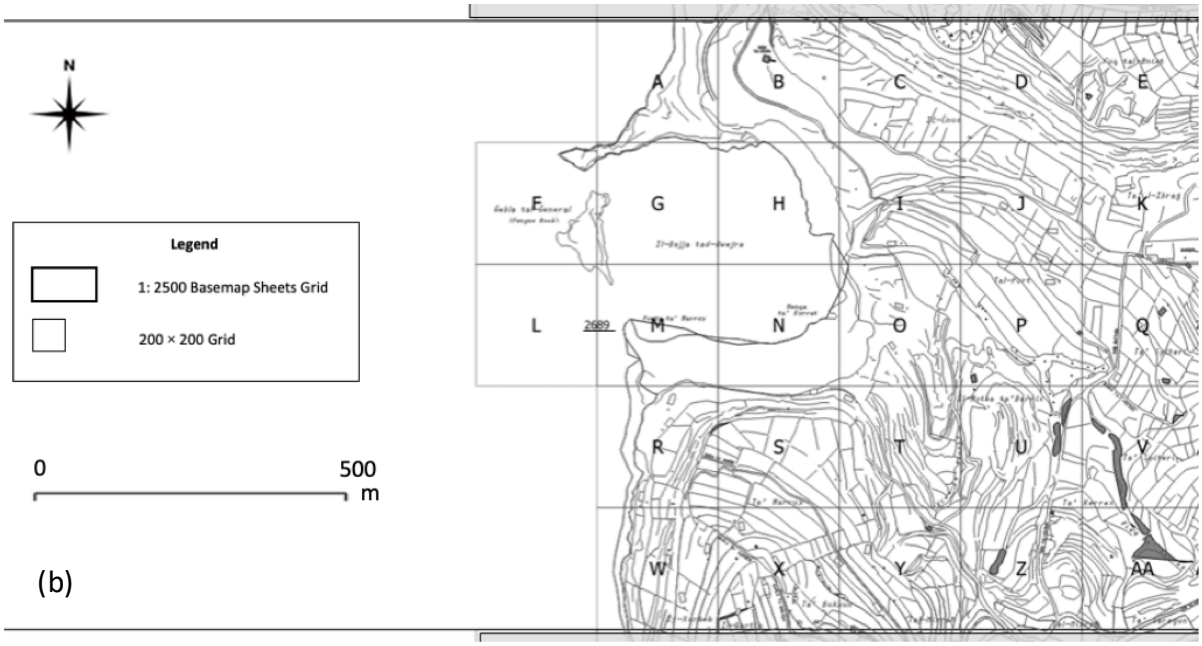
Step 3: Weighting and mapping

The identified codes were then weighted and mapped. A total of 50 survey sheets, covering the entire land area of Gozo and each with an extent of 1 x 2 km^2 (Fig. 4a), were subdivided into polygons, each measuring 200 m × 200 m (Fig. 4b). This process was carried out using a grid-maker tool within the MapInfo Professional Geographic Information Systems software package. Each of the 1782 polygons created was then assigned a unique identifier code. Every polygon was subsequently evaluated with reference to each of (i) the 89 spatial variables for landscape character, and (ii) the 45 spatial variables for landscape change. Presence/absence was used as the basis for scoring, where a score of 1 was assigned if a variable was present within a polygon, or a value of 0 if it was absent. Scores did not account for differences in spatial coverage of a specific variable within a polygon; thus, whether the coverage was 90% or 10%, a value of 1 (indicating presence) was given. Mapping was carried out initially through desk studies of topographic maps and aerial photos, with subsequent ground-truthing in the field through field visits to confirm the presence or absence of variables. Such ground-truthing was carried out whenever presence or absence could not be confirmed through other means.

Figure 4: (a - top) Subdivision of Gozo into 50 survey sheet areas each measuring 2 km^2; (b - bottom) example of subdivision of survey sheets into 200 m × 200 m polygons and assignment of identifier codes to grid cells for survey sheet no. 2689.



(a)



(b)

A weight for each variable was then derived based on the percentage of respondents referring to that variable. For example, 38% of respondents made reference to 'valleys'; in the case of the polygon with identifier code 2889A, a value of 1 was given (because valleys were present), with a corresponding weighting value of 38. This process was repeated for each of the landscape character variables, allowing for the calculation of a total value for each polygon (Table 5). The same process was repeated independently for the landscape change variables.

Table 5: Derivation of sum total weight for each polygon, based on (i) the proportion of respondents making reference to each variable, and (ii) the total number of variables present within a polygon.

Landscape character for polygon 2689 A:
(Var 1: 1 × 2%) + (Var 2: 1 × 20%) + (Var 3: 1 × 2%) + (Var 4: 0)...etc. to Var 89 = **Total value of 162.13**
Landscape change for polygon 2689 A:
(Var 1: 1× 7%) + (Var 2: 1 × 1%) + (Var 3: 1 × 3%) + (Var 4: 0)...etc. to Var 46 = **Total value of 34.33**

Data was entered into a Microsoft Excel spreadsheet and subsequently imported into the QGIS software package (version 2.18.10), with identifier codes and total weighted values for each input cell in the spreadsheet linked to a corresponding grid square on the map, enabling the transformation of georeferenced tabular data into gridded raster data. The process for generation of summation maps is described below; the summation maps enabled identification of hotspots of value.

For mapping purposes, the study utilized a natural break classification, i.e. creating data ranges according to the Jenks-Caspall algorithm (Jenks & Caspall, 1971). The algorithm is an optimal classification method for improving thematic mapping as a communicative tool, using the average of each range to distribute the data more evenly across ranges, minimizing the sum of the absolute deviations about class means (Slocum et al., 2005). It thus ensures that (i)

categories are well-represented by their average values, and that (ii) data values within each of the categories are fairly close together (Jaafari et al., 2017; MapInfo, 2007).

Step 4: Comparison between generated results of different groups and expert views

Landscape character and change maps based on the responses of the three stakeholder groups were compared through an analysis of the standard correlation between classes (Eq. 1):

$$Correl\,(X,Y) = \frac{\Sigma\,(x-\overline{x})(y-\bar{y})}{\sqrt{\Sigma(x-\overline{x})^2\Sigma(y-\bar{y})^2}} \quad \text{[Eq. 1]}$$

where $\overline{x}$ and $\bar{y}$ are the sample means AVERAGE (array 1) and AVERAGE (array 2), with the arrays being the grid values for landscape character/change for each stakeholder group.

To compare results obtained from surveys with expert views, the location of class A and B areas was obtained from Malta's Planning Authority in GIS format. Using the vector geoprocessing tools of QGIS and the results obtained from the public survey, grid cells with values > 0 for landscape character/landscape change that intersected class A and B areas were extracted using the vector 'Intersection' tool. For comparison purposes, the top two ranked classes generated by the Jenks-Caspall algorithm were considered to represent perceived high character/change areas. The process was repeated for the three sub-groups of respondents. The resulting vector files were rasterised and imported into the SAGA GIS package (version 6.2.0) to generate thematic summation maps. Related statistical data were extracted using SAGA GIS.

To explore the strength of the relationship between class A/B and landscape character and change results, shapefiles of these areas were converted to raster format, with a 5 m cell size, for use in ArcGIS Spatial Analysts extension. The Band Collection Statistics tool was then

used to produce covariance and correlation statistics, based on several combinations of ranked classes and Class A/B areas. Covariance was first calculated as per Eq. 2:

$$Cov_{ij} = \frac{\sum_{k=1}^{N}(Z_{ik-\mu_i})(Z_{jk-\mu_j})}{N-1} \quad \text{[Eq. 2]}$$

where Z is the value of a cell, i,j are layers of a stack, μ is the mean of a layer, N is the number of cells, and k denotes a particular cell. A correlation coefficient was then calculated as per Eq. 3:

$$Corr_{ij} = \frac{Cov_{ij}}{\delta_i \delta_j} \quad \text{[Eq. 3]}$$

where i,j are layers of a stack, Cov is covariance between layers i and j, and δ represents standard deviation. The analysis was repeated for several combinations of ranked classes and Class A/B areas.

As noted above, the methods through which the two sets of data compared were derived differ, and for this reason, possibilities for direct comparison are limited. Our focus, however, was on comparing the outputs of the two processes – i.e., a delineation of landscapes considered valuable/sensitive by experts, on the one hand, and a delineation of landscapes considered to be of high character/experiencing high levels of change by the public, on the other. The premises that underpin this comparison have been outlined earlier in this section.

5. Results

5.1 Perceptions of landscape character

The areas that the public perceived as having highest landscape character (dark blue in Fig. 5a) were the cliff-dominated southern and western coastlines, inland valleys, and a band of hills and plateaus running north-west to south-east. Such areas had strong natural characteristics. There is also a small hotspot of high landscape character value in the centre of the island, corresponding to the location of the medieval Citadel, a hill-top fortified settlement, which is visually dominant in the landscape. The results indicate a link between perceived landscape character and the scale of visual features, with larger and 'grander' visual elements of the landscape (hills, valleys, cliffs, fortified settlements) corresponding to hotspot character areas. Conversely, lower values were given to areas which are more easily accessible and have been more extensively modified, including low-lying coastlines and flatter land areas. The areas perceived to have the lowest character (yellow) were those that were highly developed, including the main built-up conurbation on the island around the capital Victoria, and the ferry terminal at Mgarr harbour in the south-east, which is the access point for reaching the island (Fig. 5a).

There were no statistically significant differences between landscape character aspects identified by respondents and stakeholder category ($\chi^2 = 1.29$, $p > 0.99$ as per Conrad et al., 2011b). The spatial pattern of perceived landscape character for local residents, domestic visitors and international visitors was generally similar (Figs. 5b-d and Table 6), with strong correlations between the responses of local residents/domestic visitors and of local residents/international visitors (correlation coefficient of 0.93), and with a strong but slightly weaker correlation between the results of domestic/international visitors (0.81). International visitors linked landscape character predominantly with the coast and with other areas on or

around the standard tourist trail. Local residents highlighted a wider range of areas, including towns and villages and a number of favoured recreational sites. Domestic visitors from Malta highlighted the hilly region of the island to a larger extent than other stakeholders; (it should be noted that Gozo is characteristically hillier than the flatter main island of Malta). These results suggest that different stakeholders consciously or subconsciously relate landscape character to particular landscape traits that they consider valuable - Gozitans emphasized landscape characteristics linked to their daily lives, Maltese visitors the landscape features lacking in Malta, and international tourists the coast and sea, key pull factors attracting visitors to the country.

Figure 5: Perceived landscape character: (a) top – overall results, (b) middle left – local residents, (c) middle right – domestic visitors, (d) bottom – international visitors. Yellow shading shows areas of lowest character, while dark blue shading shows areas of highest character.

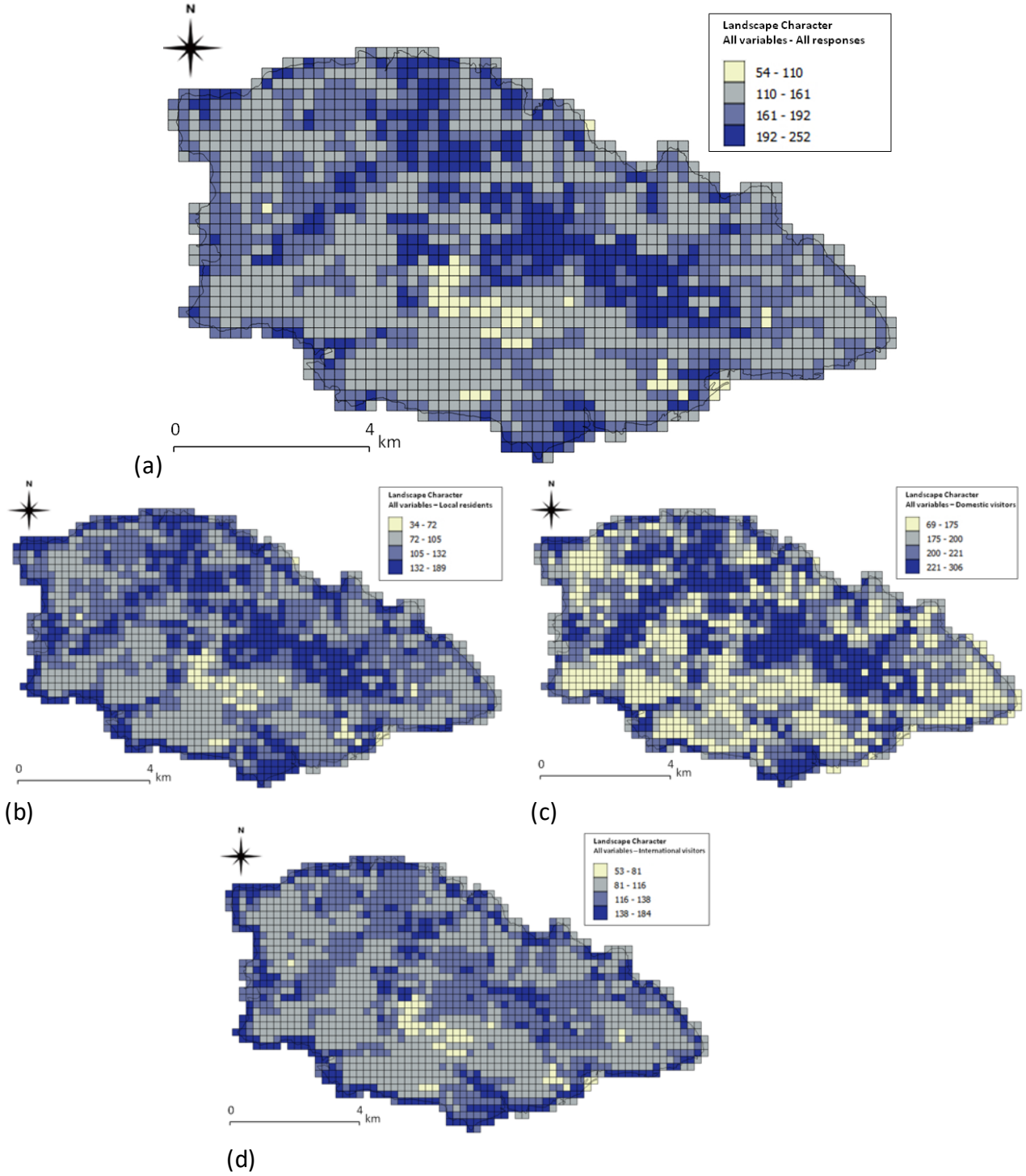


Table 6: Descriptive and correlation statistics for landscape character maps of the three stakeholder groups. Correlations between maps of the different stakeholder groups are positive and strong.

Descriptive statistics			
	Local residents	**Domestic visitors**	**International visitors**
Mean cell value	114.49	203.48	119.59
Standard deviation	24.59	32.25	19.85
Maximum cell value	189.32	305.90	184.38
Minimum cell value	33.98	68.75	53.13
Correlation statistics			
	Local residents	**Domestic visitors**	**International visitors**
Local residents		0.93	0.93
Domestic visitors	0.93		0.81
International visitors	0.93	0.81	

5.2 Perceptions of landscape change

Hotspots of landscape change were mostly located in urbanized areas (Fig. 6a). While Gozo is comparatively less developed than other parts of Malta, several areas were identified as experiencing expansion of the built footprint or changing architectural styles. Three coastal change hotspots were also identified: Marsalforn on the northern coast and Xlendi in the south-west, both of which used to be traditional fishing villages, and Mgarr harbour in the south-west, the site of the ferry terminal. Landscape change was considered to be largely detrimental in nature (perceptions of the nature of observed change were queried in the same survey and are discussed in Conrad et al., 2011b). There were also clear links between results for character and change; high character areas were generally more natural or rural in character, while high change areas tended to be more urbanised.

There were no statistically significant differences between landscape change aspects identified by respondents and stakeholder category ($\chi^2 = 30.78$, $p = 0.02$ as per Conrad et al., 2011b). Likewise, the spatial patterns of perceived landscape change were largely similar for the three stakeholder groups (Figs. 6b-d), with very strong correlations between these of 0.95–0.99 (Table 7). Some minor differences were, however, noted. International visitors, for example,

highlighted the coastal areas of Xlendi and Marsalforn, where much tourism infrastructure is concentrated; construction activity is an almost permanent feature of the landscape and change is evident, even to those unfamiliar with how the landscape would have looked previously. In contrast, local residents and domestic visitors highlighted areas of landscape change within and around other settlement areas to a greater extent; here, change may be less obvious to the casual visitor but would be noticeable to those having greater familiarity with the landscape. Such areas include parts of the hilltop settlements of Xaghra and Nadur (where ridgeline development is more highly visible than in lower lying areas), the main conurbation extending out from Victoria, and the town of Xewkija, where Gozo's main industrial complex is located. It was interesting to note that locals identified not only sites of *actual* change, but also a number of sites for which development ideas had merely been floated and where change is therefore a latent threat.

Figure 6: Perceived landscape change: (a) top – overall results, (b) middle left – local residents, (c) middle right – domestic visitors, (d) bottom – international visitors. Yellow shading shows areas experiencing least change, while dark blue shading shows areas experiencing most change.

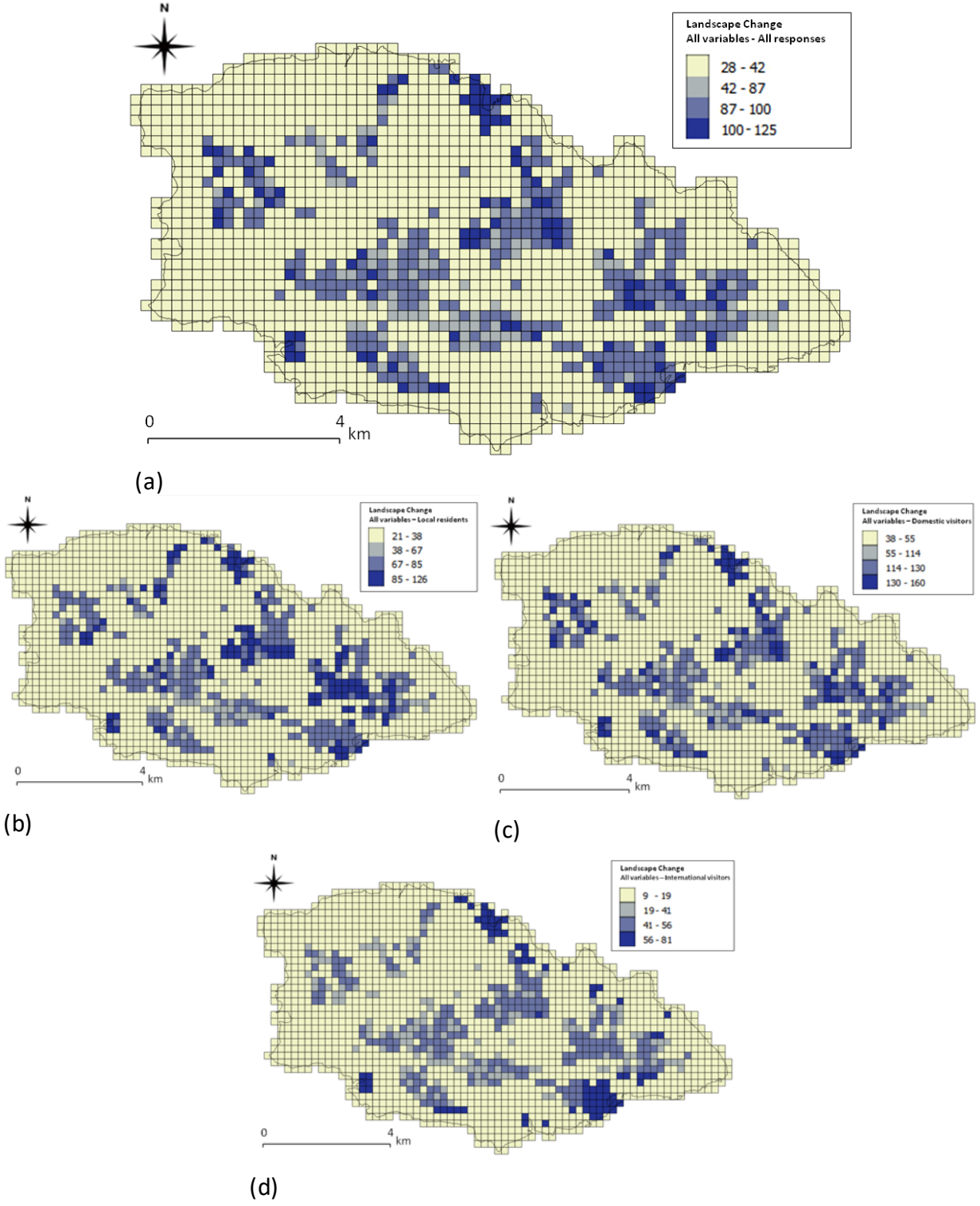


Table 7: Descriptive and correlation statistics for landscape change maps of the three stakeholder groups. Correlations between maps of the different stakeholder groups are positive and strong.

Descriptive statistics			
	Local residents	**Domestic visitors**	**International visitors**
Mean cell value	38.7	61.30	20.22
Standard deviation	24.91	36.12	17.10
Maximum cell value	126.21	160.07	81.25
Minimum cell value	21.36	37.85	9.38
Correlation statistics			
	Local residents	**Domestic visitors**	**International visitors**
Local residents		0.99	0.95
Domestic visitors	0.99		0.97
International visitors	0.95	0.97	

5.3 Comparison with expert views

Overall, there was a poor fit between what participants considered to be areas of high landscape character and areas considered to be of high landscape value by experts (class A and B areas). While there is some overlap between these (Fig. 7), less than half (49%) of areas highest ranked by respondents lie within such areas (27% within class A and a further 22% within class B), and almost a quarter (24%) of landscapes considered to be of high character by participants do not lie within any such areas. On the other hand, many areas considered to be of value by experts (73% and 78% of class A and B areas, respectively) were not considered to be of 'top' landscape character by respondents, and even include sites ranked within the lowest character class by respondents (0.4% and 2% of class A and B areas, respectively) (Fig. 8). These results were also validated statistically, through an analysis of the correlation between areas identified by the public and those identified by experts (Table 8); correlation coefficients ranged between 0.13 and 0.27, indicating very weak correlations in all cases and confirming clear differences between expert and public judgments.

Figure 7: Areas of perceived high character (according to public) lying within landscapes of high value (according to experts). Red shading shows high character areas lying with class A areas (highest value landscapes identified by experts), while blue shading shows high character areas lying within class B areas (second highest value).

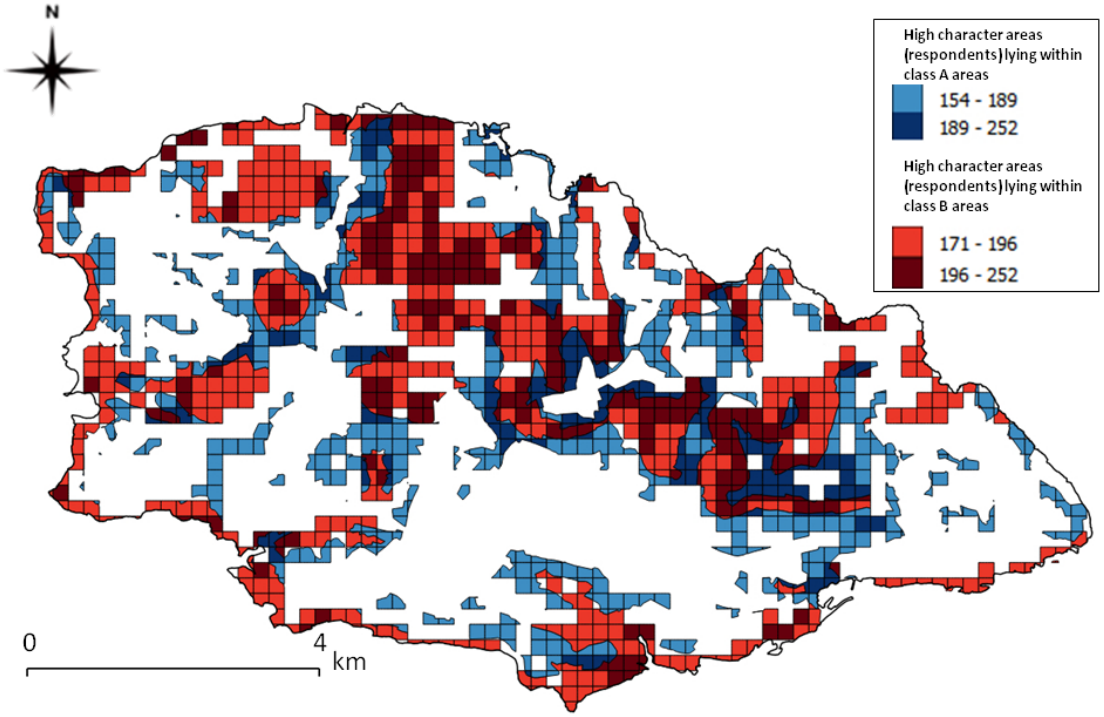


Figure 8: High value landscapes identified by experts (class A/B areas) that were not considered to be of high character by the public.

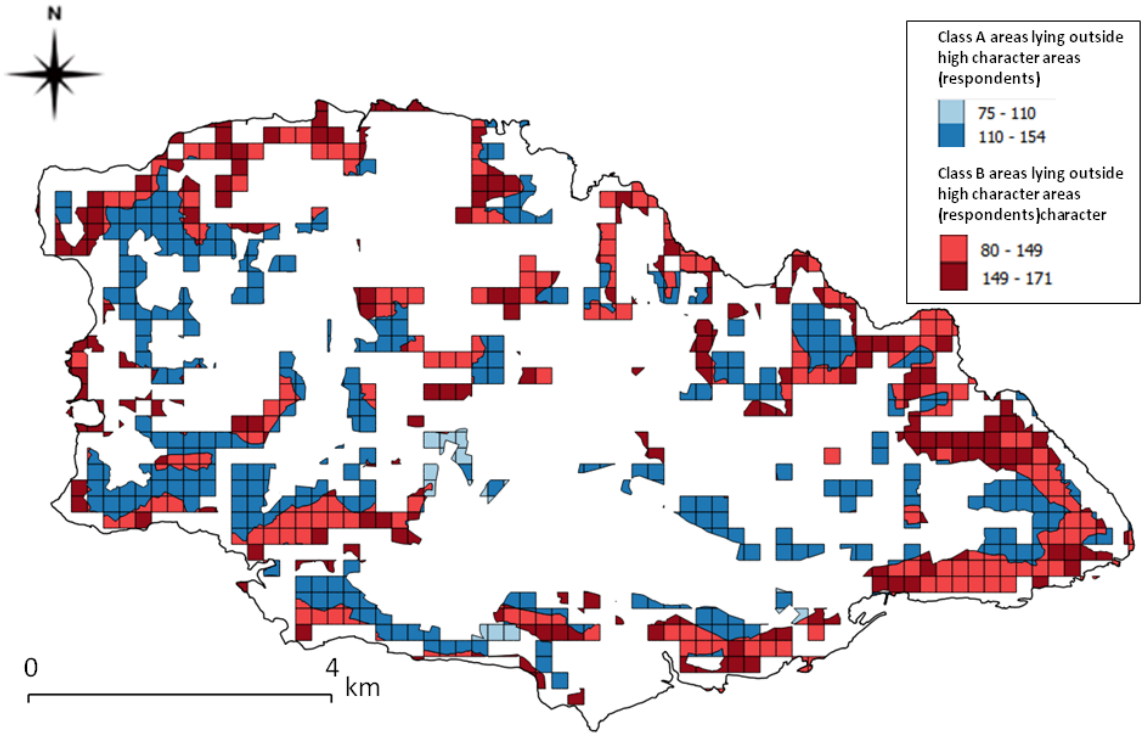


Table 8: Correlation between Class A/B areas and survey-based maps for landscape character, showing positive but weak correlation coefficients in all cases. The distribution of Class A/B areas is shown in Fig. 2, while the categorization/distribution of landscape character classes is given in Fig. 5.

Public survey-based results (character)		**Expert results**	**Correlation coefficient**
Top class	WITH	Class A	0.18
Top two classes		Class A and B areas	0.13
All classes		Class A and B areas	0.27

Our results also showed very poor fit between class A and B areas and those considered to be experiencing high landscape change by respondents. This is an important finding because, as noted above, class A and B areas were those considered to be of highest sensitivity by experts. However, only around a quarter of areas perceived as experiencing most change by respondents presently lie within such areas (13% within class A and 14% within class B) (Fig. 9). Conversely, areas considered to be experiencing least change (bottom two response classes) covered 84% and 70% of class A and B areas, respectively. Correlation coefficients were weak, ranging from -0.07 to -0.23 (Table 9). This result could be interpreted in two ways. On the one hand, this could be a positive indication that high-sensitivity areas (as identified by experts) have thus far been successfully safeguarded from change, because of controls on development. On the other hand, however, the result could also mean that areas considered by the public to be most in need of protection or management are not presently receiving it; based on survey responses, there appears to be very evident public concern with landscape change in urban areas but class A and B areas shortlisted by experts specifically exclude several urban centres. It is not clear whether this is because urban areas were not considered sensitive at the time when the LAS was conducted, or whether their relative sensitivity was considered lower than that of rural/natural areas. However, it is worth bearing in mind that urban areas provide the predominant context for the day-to-day-lives of most residents and change is therefore more

likely to be strongly experienced within such areas. Related results are also discussed in further detail in Conrad et al., 2011b.

Figure 9: Areas perceived as experiencing high landscape change (by public) that lie within landscapes of high value (as identified by experts). Blue shaded areas show class A areas (highest value landscapes identified by experts), while red shading shows class B areas (second highest value).

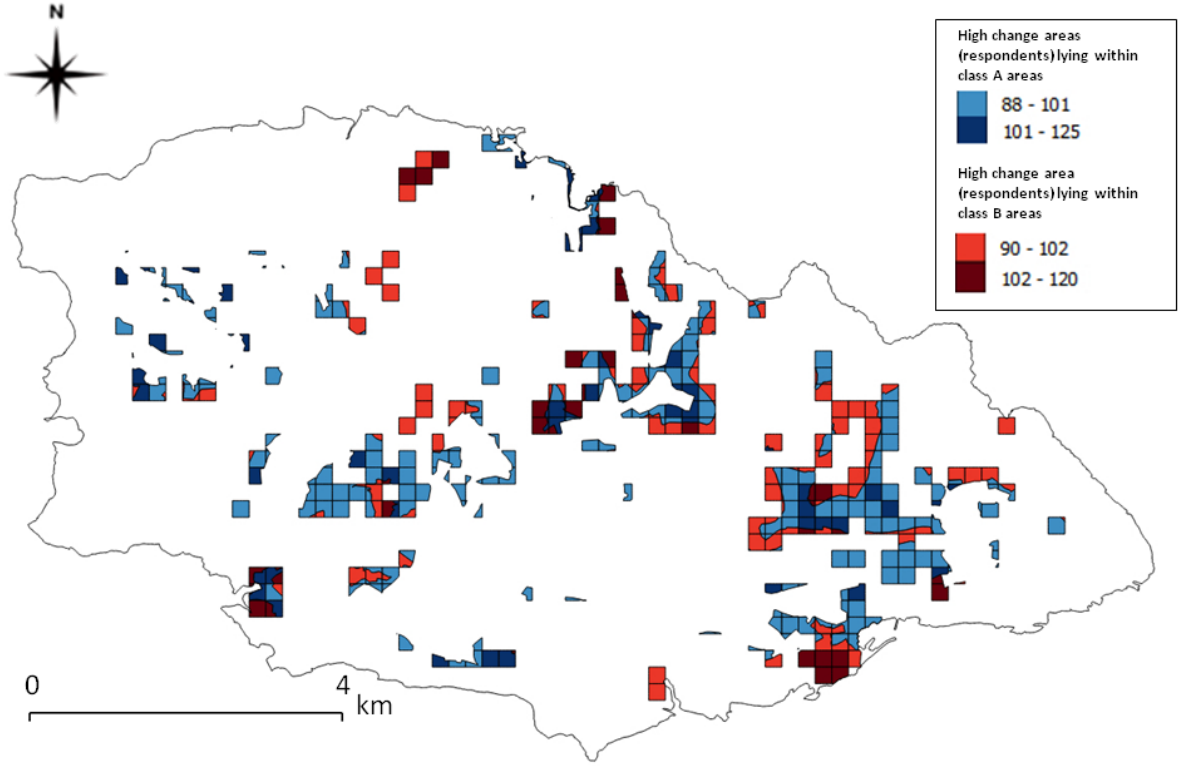


Table 9: Correlation between Class A/B areas and survey-based maps for landscape change, showing negative and weak correlation coefficients in all cases. The distribution of Class A/B areas is shown in Fig. 2, while the categorization/distribution of change classes is given in Fig. 6.

Public survey-based results (change)		**Expert results**	**Correlation coefficient**
Top class	WITH	Class A	-0.07
Top two classes		Class A and B areas	-0.17
All classes		Class A and B areas	-0.23

6. Discussion

The aim of this research was to examine how both landscape character and change are perceived by the public, and the extent to which these perceptions agree with those of experts. There are three key findings from this study. First, areas recommended for protection by experts do not appear to accurately or sufficiently reflect public perceptions. Second, urbanization is considered to be a major negative driving force of landscape change. Third, judgments of character are influenced by the presence or absence of landscape traits, some of which are considered to be of different value to different respondents. Each of these findings is discussed in more detail below.

Results show limited agreement between landscapes recommended for designation by experts and those considered as possessing high character by respondents in our study; this discrepancy between expert and lay views is echoed in literature from both landscape-related (Bezák and Bezáková, 2014; Eiter, 2010) and other fields (Blok et al., 2008; Castán Broto, 2012; Weng, 2015). Such a mismatch may point to fundamental shortcomings in how landscape planning is conducted in Malta. Even if the country has completed a landscape assessment exercise, our results suggest that it has not done so in the spirit and manner envisaged by the ELC – i.e. "taking into account the particular values assigned to [landscapes] by…interested parties and the population concerned".

It is important to emphasize that, while this work has highlighted the important contribution of public input, we also see an important continuing role for technical experts, particularly to capture aspects of the landscape that may not be well known or understood (e.g. ecological or historical heritage value). Indeed, it could be the case that some of the mismatches noted in our results are because experts identified landscape values that are not evident to lay people.

However, it is also possible that there are fundamental differences in what experts and the public value; for example, while the expert assessment was based heavily on visual aesthetic criteria, people's responses may take much greater account of the landscape as a context for activities (e.g. Eiter, 2010). It is indeed clear from the results that the public value several areas that experts do not value to the same degree. At a minimum, this suggests a strong need for (i) considering both public perception and expert judgment, as complements rather than substitutes; each is necessary but insufficient on its own, and (ii) better communication between experts and the public, both for experts to explain to the public why certain values/areas are considered important from a technical point of view, and also for them to listen to and incorporate the views of the communities living within those landscapes in their assessments. This conclusion echoes that of de Groot et al. (2014), who found that there is much potential for social learning through use of methods that make public values more manifest and that seek to acquaint non-experts and experts in development of a shared vision.

Our second key finding, i.e., that urbanization is a major driver of negative landscape change, has significant implications for land use planning in Gozo. The Maltese Islands generally have a very high rate of urban land cover (>30%), but Gozo is characteristically more rural than the main island of Malta. Indeed, one of the distinguishing landscape features of Gozo is that towns and villages are generally still separated by clear boundaries, whereas Malta has seen extensive urban sprawl that has created a single large urban conurbation. The results of this study suggest (i) that less developed landscapes are especially highly valued by all respondent groups and need to be strongly safeguarded, and (ii) that processes of urban growth within and on the boundaries of existing urban areas need to be better managed. Protectionist landscape approaches are therefore necessary but insufficient; at least two more elements are needed. First, there should be mechanisms to allow evaluation of the landscape impact of development

proposals; while Landscape and Visual Impact Assessments are presently conducted for some major developments, we argue here for a mechanism that can be applied when evaluating any development applications with potential landscape impacts. Second, there needs to be a strategic and coherent vision of how landscapes in Gozo should evolve (the ELC talks specifically of defining landscape quality objectives). Both of these are presently lacking, with resultant evident negative impacts in terms of landscape coherence, condition and quality that were highlighted repeatedly by respondents in our study.

Third, our results show subtle differences between the results of different respondent groups, confirming that judgments of landscape character are influenced by subjective perception, experience and values, similar to conclusions drawn by Carvalho-Ribeiro et al. (2013) and Trop (2017). For this reason, public participation approaches that are not tailored to specific audiences, but that are merely open to those who want to participate – such as open public consultations – may do a poor job of representing the spectrum of values and views within a community. We suggest that future landscape planning initiatives in the Maltese Islands should be guided by a stakeholder analysis, to identify different interest groups, followed by targeted efforts to capture the views of these different groups, actively seeking diversity. This finding also highlights the importance of recognizing and acknowledging the inherent and unavoidable subjective bias even of those acting as experts (Baybutt, 2018; Mizrahi, 2018).

These results call for more focus on how the participatory approach to landscape protection, planning and management advocated in the ELC can be implemented by planners in practice. The method presented in this study offers one option for increasing public input in planning processes. Innovative methods have also been identified by e.g. Mercado-Alonso et al. (2018) and Santé et al. (2018), while Eiter and Vik (2015) identify suites of verbal and visual methods

that have proven effective in the Nordic context. However, the uptake of such research by planners remains challenging, partly because of constraints of the policy-making environment, especially lack of time to engage with research, but also because of insufficient exchange of experiences amongst landscape professionals, and because of the rigidity of planning frameworks that do not easily allow adoption of new methods. These challenges need to be more explicitly addressed, with special emphasis on bridging the gap between landscape research and practice.

This research also indicates scope for adopting more nuanced definitions of landscape change and sensitivity. In our case study area, landscape policies have tended to consider landscape character, value and sensitivity as related; these concepts are, however, not sufficiently clearly defined and differentiated. Our results suggest that the public makes important distinctions between landscapes currently experiencing change, landscapes that are threatened with change, as well as landscapes where the impact of change could be particularly severe. To clarify these distinctions for landscape planning purposes, it may be useful to adopt a taxonomy of landscape vulnerability, comprised of three elements: (i) exposure to (negative) change, (ii) adaptive capacity, and (iii) sensitivity. In this context, exposure refers to the duration or extent of exposure to negative drivers of change, adaptive capacity refers to the ability of a landscape to absorb change without loss of character or quality, while sensitivity refers to the degree to which landscapes and/or their communities are affected by change.

Limitations

Four main limitations of the research should be borne in mind when interpreting results. First, the use of an internet survey may have precluded responses from certain segments of the population, even if internet penetration in Malta is high at 80% of the general population

(National Statistics Office, 2018b). Second, the use of a snowball sampling technique led to unequal responses from the three respondent groups, with the greatest number of responses from domestic visitors, who make up the largest segment of the Maltese population, a smaller number of responses from Gozitan residents, and a small sample of responses from international visitors. In consequence, there are differences in the extent to which these results can be considered representative of each of these groups; however, it should be noted that for purposes of comparing results with expert views, we considered the respondent sample as a whole. Third, even though the method allows for capture of 'special places', with which a respondent may have an affective bond, it does not allow for adequate capture of intangible values that cannot be easily mapped, such as those that relate to culture in general. This aspect requires further methodological development. Fourth, responses from members of the public are limited by their level of familiarity with the landscape; it is possible that some respondents may simply not be aware of specific landscape features. This limitation is especially relevant in the case of international visitors, who may only visit a few sites during their time on the island; conversely, both domestic visitors and local residents can be reasonably expected to have a high degree of familiarity with the landscape, especially when considering the island's small size.

7. Conclusions

This paper has shown that there are major deficiencies in expert-based designation processes in terms of their ability to reflect the views of the wider public about what they consider to be important and in need of protection. Our results suggest there may be a need to consider the perspectives of the wider public when deciding which landscapes to protect, and to actively seek out the views of community subgroups. While the role of technical experts remains vital, greater participation is important to ensure that areas considered valuable by communities are

adequately protected and for those in local communities to be active players in managing landscape threats and vulnerabilities. New, more participatory methods, such as those used in this paper, that harness opportunities offered by digital media, are also needed in order to render planning practices more participatory and to increase the involvement of the public in planning processes. Mechanisms are also needed to facilitate the uptake of such methods by planning professionals. Furthermore, more effort is needed to identify suitable and effective means for managing landscape change outside protected areas, such as through identification of landscape quality objectives, design guidelines, and controls on new development. Overall, in an era of major landscape change, this study shows that expert judgment is necessary but in no way sufficient, and that we need to give due consideration to finding ways to understand evolving notions of what people value and how best such perceptions can be elicited and represented in planning.

Acknowledgments

The authors are indebted to three anonymous reviewers for useful feedback on previous versions on this paper. We would also like to thank Ms. Crona Hodges for assistance with statistical analysis.

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Supplementary data

Table S1: Mapping variables for landscape character.
(place-names listed in *italics*)

	Variable	Cited by % of respondents (n = 478)	Interpretation
1	Hills	37.66	
2	Agricultural land cover	33.26	
3	Countryside	28.9	Areas of agricultural and/or natural land cover
4	Unbuilt land	21.13	
5	Valleys	18.41	
6	Natural land cover	18.2	
7	Coast	13.18	
8	*Citadel*	10.25	
9	*Ramla*	10.25	
10	Cliffs	9.83	
11	Spatial separation between towns/villages	9.83	Towns/villages which are not spatially linked to other settlements
12	Traditional architecture	9.41	Farmhouses, terraced houses, detached/semi-detached houses
13	*Dwejra*	7.95	
14	*Ta Cenc*	6.9	
15	Hill-top settlements	6.07	
16	Geological outcrops	5.65	
17	*Azure window*	5.44	
18	Towns and villages	5.23	
19	Churches	4.81	
20	*Xlendi*	4.6	
21	Historical heritage features	4.18	
22	*Mgarr ix-Xini*	3.77	
23	Streets	2.93	
24	Plateaus	2.72	
25	*Ghasri valley*	2.72	
26	Beaches	2.51	
27	*Mgarr harbour*	2.51	
28	*Ggantija*	2.1	
29	Bays	2.09	
30	Town/village core areas	2.09	Urban Conservation Areas (as defined by the Malta Environment and Planning Authority) which approximate the historical core area of settlements
31	*Lunzjata valley*	1.88	
32	*Fungus Rock*	1.67	
33	*Hondoq ir-Rummien*	1.67	
34	Salt pans	1.67	
35	*Ta' Pinu*	1.67	
36	*Gordan lighthouse*	1.46	
37	*Marsalforn*	1.46	
38	*Nadur*	1.46	
39	*San Blas*	1.46	
40	*Qala*	1.26	
41	*Dahlet Qorrot*	1.05	
42	*Qbajjar*	1.05	
43	*Rabat*	1.05	
44	*Xaghra*	1.05	

45	*Gharb*	0.84	
46	*Ghasri*	0.84	
47	*Inland Sea*	0.84	
48	*Gordan hill*	0.63	
49	*Salvatur hill*	0.63	
50	*San Dmitri cliffs*	0.63	
51	Coastal towers	0.42	
52	*Ghadira ta' San Raflu*	0.42	
53	*Ghajn Barrani*	0.42	
54	*Ghammar hill*	0.42	
55	Karstic land-cover	0.42	
56	Plains	0.42	
57	*San Lawrenz*	0.42	
58	*Sannat cliffs*	0.42	
59	Soil outcrops	0.42	
60	*Mielah valley*	0.42	
61	*Xewkija church*	0.42	
62	*Xwejni*	0.42	
63	*Zebbug*	0.42	
64	Aqueducts	0.21	
65	Boulder screes	0.21	
66	*Calypso's cave*	0.21	
67	Caves	0.21	
68	Fortifications	0.21	
69	*'Fossil rocks' at Dwejra*	0.21	
70	*Ghajnsielem*	0.21	
71	*Kantra (Xlendi)*	0.21	
72	*Kola windmill*	0.21	
73	Limestone buildings	0.21	
74	*Lourdes church (Ghajnsielem)*	0.21	
75	Natural arches	0.21	
76	Historical towers	0.21	
77	Prehistoric features	0.21	
78	*Qolla l-Bajda*	0.21	
79	*Qolla s-Safra*	0.21	
80	Sandy land-cover	0.21	
81	Sand dunes	0.21	
82	*Ta' Dbiegi*	0.21	
83	Temple sites	0.21	
84	*Raheb valley*	0.21	
85	*Rahhan valley*	0.21	
86	*Sabbar valley*	0.21	
87	*Marsalforn valley*	0.21	
88	Windmills	0.21	
89	*Xewkija*	0.21	

Table S2: Mapping variables for landscape change.
(place-names listed in *italics*)

	Variable	Cited by % of respondents (n = 478)	Interpretation
1	General urbanization	50.42	Sites of new building permits issued between 1998 and 2008*
2	Changing architectural styles	12.13	Sites of building permits issued for construction of apartment blocks and/ or penthouses (both new developments and conversions) between 1998 and 2008*
3	Urbanization outside towns/villages	10.46	Sites of building permits issued between 1998 and 2008 which lie outside established development zones (ODZ areas) *
4	*Xlendi*	6.07	
5	*Marsalforn*	5.86	
6	High-rise development	5.65	Areas within development zone boundaries where permitted building heights are over four storeys*
7	Urbanization on ridges	4.6	Sites of building permits issued between 1998 and 2008 which lie on topographical ridges*
8	*Dwejra*	3.97	
9	Coastal development	3.77	Sites of building permits issued between 1998 and 2008 which lie in proximity to the coast*
10	*Mgarr* harbour	2.72	
11	Agricultural abandonment	2.3	Agricultural land showing evidence of abandonment, based on Cassar (2010)
12	*Chambray* development	2.3	
13	*Ta' Cenc*	2.3	
14	*Hondoq ir-Rummien*	2.09	
15	Afforestation areas	1.88	
16	*Ramla*	1.88	
17	Ribbon development	1.88	Linear development along roads linking settlements
18	Quarries	1.67	
19	*Rabat*	1.67	
20	Beaches potentially affected by erosion	1.46	All beaches
21	Habitat loss	1.46	Based on mapping of habitat loss across Gozo carried out by Cassar (2010)
22	*Nadur*	1.26	
23	*Zebbug*	1.05	
24	Urbanization in valleys	0.63	Sites of building permits issued between 1998 and 2008 which lie within valleys
25	*Ghajnsielem*	0.63	
26	Landfill	0.63	
27	Large-scale projects	0.63	Sites of recently implemented/proposed major projects
28	*Nadur* cemetery	0.63	
29	*Qala*	0.63	
30	*Rabat* suburbs	0.63	
31	*San Lawrenz*	0.42	
32	*Xaghra*	0.42	
33	*Xewkija* church	0.42	
34	Beach kiosks	0.21	
35	Buildings between *Rabat* and *Zebbug*	0.21	

36	*Gharb*	0.21	
37	*Ghasri*	0.21	
38	*Kenuna tower*	0.21	
39	Buildings between *Munxar* and *Rabat*	0.21	
40	Changes in character of former small fishing villages	0.21	Settlements of *Marsalforn* and *Xlendi*
41	*Munxar*	0.21	
42	*Qbajjar*	0.21	
43	Race course	0.21	
44	*Tokk*	0.21	
45	*Xwejni*	0.21	

* Based on publicly available data provided through the Planning Authority's Map Server.